

CLAIMS

1. A composition for improving the reheat characteristics of a polymeric material,
5 the composition comprising an inorganic material.
2. The use of an inorganic material for improving the reheat characteristics of a polymeric material.
- 10 3. A concentrated formulation for addition to a polymeric material or to one or more monomers or oligomers or prepolymers arranged to be polymerised to prepare a polymeric material, said formulation comprising a carrier and an inorganic material.
- 15 4. A formulation according to claim 3, which includes a carrier which is solid at STP thereby to define a solid masterbatch; or includes a liquid carrier wherein the inorganic material is dissolved or dispersed in the liquid carrier.
- 20 5. A formulation according to claim 3 or claim 4, which includes less than 90wt% of inorganic materials.
6. A formulation according to any of claims 3 to 5, wherein a said liquid carrier comprises a vegetable, mineral oil or a glycol.
- 25 7. A method of improving the reheat characteristics of a polymeric material, the method comprising contacting the polymeric material or contacting one or more monomers or oligomers or prepolymers arranged to be polymerised to prepare the polymeric material with an inorganic material.
- 30 8. A method according to claim 7, wherein said polymeric material or said monomers are contacted with a powder which comprises or consists essentially of said inorganic material; or contacted with a concentrated formulation as described in any of claims 3 to 6.
- 35 9. A method according to claim 7 or claim 8, wherein granules or pellets which comprise the polymeric material and inorganic material are prepared.

10. A product comprising a polymeric material and an inorganic material for improving the reheat characteristics of the polymeric material.
- 5 11. A product according to claim 10, said product including at least 0.01ppm and less than 1000ppm of said inorganic material based on the weight of said polymeric material.
12. A product according to claim 10 or claim 11, which is in the form of pellets or
10 granules.
13. A product according to any of claims 10 to 12, wherein the product is a moulded article.
- 15 14. A method of making a product according to any of claims 10 to 13, the method comprising heating a composition comprising a polymeric material and an inorganic material and forming the composition into a shape to define the product.
- 20 15. A method according to claim 14, wherein, in said method, the composition is heated using an infrared source.
- 16 16. A composition, use, formulation, method or product according to any preceding claim, wherein said inorganic material for improving the reheat characteristics of
25 a polymeric material is such that a 2.5mm thick polyethylene terephthalate plaque incorporating the inorganic material has, when tested, an absorption ratio of less than 0.9, wherein the absorption ratio is either the ratio of A1/A2 or the ratio A1/A3, wherein:

30 A1 is the maximum absorption between 400nm and 550nm;
A2 is the maximum absorption between 700 to 1100 nm;
A3 is the maximum absorption between 700 to 1600 nm.

17. A composition, use, formulation, method or product according to claim 16, wherein said absorption ratio is less than 0.8.
- 5 18. A composition, use, formulation, method or product according to claim 16 or claim 17 wherein for the selected inorganic material at least one of the following applies: the absorption ratio $A1/A2$ is less than 0.65; and/or the absorption ratio $A1/A3$ is less than 0.85.
- 10 19. A composition, use, formulation, method or product according to any of claims 16 to 18, wherein the absorption ratio is less than 0.5.
20. A composition, use, formulation, method or product according to claim any preceding claim, wherein said inorganic material is not black carbon, iron oxide, copper chromite, metallic antimony or iron phosphide.
- 15 21. A composition, use, formulation, method or product according to any preceding claim, wherein the inorganic material is colloidal or nanoparticulate matter.
- 20 22. A composition, use, formulation, method or product according to any preceding claim, wherein the inorganic material is capable of increasing energy absorption of the polymeric material in the range of 700 to 1400 nm.
- 25 23. A composition, use, formulation, method or product according to any preceding claim, wherein the inorganic material has an average energy absorption maximum in the range of 700 to 1400 nm which is greater than the average energy absorption in the range of 400 and 700nm.
- 30 24. A composition, use, formulation, method or product according to any preceding claim, wherein the inorganic material comprises particles, the size of which is used to increase the absorption of energy between 700 and 1400 nm.
- 35 25. A composition, use, formulation, method or product according to any preceding claim, wherein the average particle size of the inorganic material is 100 nm or less.

26. A composition, use, formulation, method or product according to any preceding claim, wherein at least 90% of said inorganic material comprises particles having a maximum dimension which is less than 10 microns.
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27. A composition, use, formulation, method or product according to any preceding claim, wherein at least 95% of said inorganic material comprises particles having a maximum dimension which is less than 10 microns.
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28. A composition, use, formulation, method or product according to any preceding claim, wherein at least 95% of said inorganic material comprises particles having a maximum dimension which is less than 500 nm.
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29. A composition, use, formulation, method or product according to any preceding claim, wherein the inorganic material is produced from a material selected from one or more of the following group of materials: elemental metals, oxides, doped oxides, mixed oxides, nitrides, silicides or boride compounds.
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30. A composition, use, formulation, method or product according to any preceding claim, wherein the inorganic material is produced from a material selected from one or more of the following groups of materials: titanium nitride, zirconium nitride, indium tin oxide, reduced indium tin oxide, antimony tin oxide, gold, silver, molybdenum or tantalum.
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31. A composition, formulation or product according to any claim dependent on any of claims 1, 3 or 10, wherein the composition, formulation or product further comprises one or more colourants.
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32. A composition, formulation or product according to any claim dependent on any of claims 1, 3 or 10, wherein the composition, formulation or product further comprises one or more black or grey body infrared absorbing materials.

33. A composition, formulation or product according to claim 32, wherein the black body or grey body infrared absorbing material comprises black carbon, metallic antimony, iron oxide, copper chromite or iron phosphide.
- 5 34. A composition, use, formulation, method or product according to any preceding claims, wherein said inorganic material has an absorption at 475 nm which is less than the absorption at each of 550 nm, 600 nm and 700 nm.
- 10 35. A composition, use, formulation, method or product according to any preceding claim, wherein said inorganic material comprises titanium nitride.
36. A composition, use, formulation, method or product according to any preceding claim, wherein the polymeric material comprises a thermoplastic polymer.
- 15 37. A composition, use, formulation, method or product according to claim 35, wherein the thermoplastic polymer is selected one or more of the following groups from the group of polymers: polyesters, polycarbonates, polyamides, polyolefins, polystyrenes, vinyl polymers, acrylic polymers and copolymers and blends thereof.
- 20 38. A composition, use, formulation, method or product according to any preceding claim, wherein the polymer is poly(ethylene terephthalate) or a copolymer thereof; or polypropylene or oriented polypropylene.
- 25 39. A composition, use, formulation, method or product according to any preceding claim, wherein said inorganic material is selected to give rise to a preform with a higher % reheat per unit of lightness lost ratio than an equivalent preform made from a polymer containing black carbon, iron oxide, copper chromite, iron phosphide or metallic antimony formed by the reduction of antimony trioxide.
- 30 40. A method of improving the reheat characteristics of a polymer by adding an inorganic material to the polymer prior to reheating, said inorganic material not being black carbon, metallic antimony, iron oxide, copper chromite or iron phosphide.

41. A method according to claim 40, wherein the method is used for injection moulding articles.
- 5 42. A method as claimed in claim 40 or claim 41, wherein the polymer and/or the additive is dispersed in a liquid.
43. A method as claimed in claim 42, wherein liquid can be applied to the polymer at the polymerization stage or the injection moulding stage.
- 10 44. A method as claimed in claim 41, wherein the article is a container preform.
45. A method as claimed in claim 44, wherein the container preform is stretch blow moulded using infrared heating lamps to form a container suitable for holding liquids.
- 15 46. A method as claimed in claim 45, wherein the stretch blow moulded container suitable for holding liquids is a beverage bottle.
- 20 47. A composition, use, formulation, method or product according to any preceding claim, wherein said inorganic material comprises titanium nitride and said polymeric material comprises polyethylene terephthalate, polypropylene or oriented polypropylene.
- 25 48. A composition, use, formulation, method or product according to any preceding claim, wherein said inorganic material comprises titanium nitride and said polymeric material comprises polyethylene terephthalate.